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Differences in ASR Experiments Between the Short and Long Term Test Methods

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Abstract

The main objective of this study is to compare the effect of alkali-silica on concrete from a previous experiment by Stanton in the forties of the last century, which was the basis for researchers to investigate and study the extent of alkali-silica reaction against concrete, by various methods for testing the reaction of alkali-silica. From that point on, scientists have tried to develop testing techniques that can be used quicker to detect the effect of alkali-silica on concrete, and 16 alkali-silica testing methods have been highlighted in this study both in short and long-term terms. These methods have been chosen at random but the chronology and most of their details, how they have been performed, the materials used in this test, etc. have been determined. In the same way, the results of the test methods were explained and the available studies, research, and specifications were followed. Finally, the selected test methods have been compared and the parameters used to compare the test methods were as follows: duration, temperature, specimen size, mix type, used materials, admixtures, water/cement ratio, and expansion limit. The comparison took three forms, the first was a comparison between short-term methods alone and the second was a comparison between long-term methods alone, while the latter was between the two method types using standard concrete practices for civil work structures (EM 1110-2-2000).

Keywords: Alkali-Silica Reaction; Short-term; Long-term; Expansion limit; ASTM; EM 1110-2-2000.

1. Introduction

In the 1920s and 1930s, several buildings in California, the US developed a major breakdown in a matter of years. In 1940, Stanton showed that this was mostly due to the expansion of the alkaline aggregate. Another expansionary deterrent, called the alkaline-carbonate reaction, was reported by Swenson in 1957.

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Since then, several international conferences have been held in many parts of the world to address specific problems caused by the development of alkaline aggregate. Alkali aggregate expansion (AA) involves a chemical reaction between alkali hydroxides, typically obtained from reactionary and concrete ingredients, in aggregates. Besides alkali-silica reaction. Alkali aggregate expansion (AA) involves a chemical reaction between alkali hydroxides, typically obtained from reactionary and concrete ingredients, in aggregates. A third form known as the alkali-silicate reaction, comprising clay and gray wax, has been proposed in addition to the expansion reaction from alkali-silicate carbonate. The reaction is usually slow and the mechanism is not fully identified. Overall, the first step reacts to the formation of an alkali-silica gel by hydrolyzing reactive silica from OH and, as a result, overlaps with the uptake of water by gel.

Many factors affect the Alkali-Silica reaction. The most important ones are:

The Nature of Reactive Silica, Amount of Reactive Material, Reactive Material particle size, Content of alkali sodium and potassium, Humidity and Temperature [1,2].

2. Test Methods

2.1 T.E. Stanton method

California Highway Division 1st established the ASR. T.E. Stanton (1940) Started in1938, he continued his analysis on ASR reaction and take a look at ways to see aggregates' potentials for ASR for five years. The growth ascertained was found to be negligible if the alkali content of cement was but 0.6 percent. The ASTM C227 normally take a look at methodology was supported his work (mortar-bar test) in 1940. He found that sure mineral components, like sure varieties of shales, cherry, and impure California found on the shores of the American state, were on paper suspected of triggering a harmful expansion [3].

2.2 ASTM C227

This approach deals with the sensitivity of the mix of cement to expansionary reactions involving hydroxyl radical ions (sodium and potassium) related to the alkalescent. The approach isn't suggested for the detection of the alkali-carbonate reaction. The temperature of the molding space and dry materials shall be preserved at not but 20° C and no more than 27.5° C. The wet jar or space should be C511 compatible. The space for storing, within which the instrumentation samples area unit is maintained, shall be 38 °C. The fine aggregate shall be tested apart from the removal of any material maintained on the 4.75 mm (No.4) sieve. And any coarse Aggregate is classified consistent with the necessities of the table below.

Grading Requirements

In all cases, cement with an alkali content above 0.60% should be used compared with Na2O. The cement used shall signify the highest amount of alkaline materials for general use and the sieve to be used for this purpose shall be tested (no. 20) and looked at before use for removal of lumps [4].

Table 1

Sieve Size Passing	Retained on	Mass %
No. 4	No. 8	10
No. 8	No. 16	25
No. 16	No. 30	25
No. 30	No. 50	25
No. 50	No. 100	15

2.3 ASTM C289

This test method treats during a chemical evaluation using a 24-hour response rate at 80 ° C with 1N caustic soda and aggregates that have been crushed and sieved to pass a 300 μm sieve and retained on a 150 μm sieve, the possible reactivity of an aggregate with alkali during a hydraulic cement concrete. In connection with other approaches, this method is used to evaluate the silicon reactivity in aggregates with alkali in hydraulic concrete. Reactions between response from caustic soda and silicon components have been shown to occur within the aggregate. Test results are often easy to obtain and, while not entirely accurate, useful data are often given in aggregate. For fine or coarse aggregates, the test can be used. Exercise D75 gives you the aggregate sample. Divide the specimen according to Exercise C702 for specimens of aggregates with a maximum nominal size of 19 mm or less or 19 mm or more. Sift the specimen into the jaw in small pieces at a time. Crusher in which all fractions are kept until a 4.75 mm (No. 4) sieve passes the sample. The equipment is run through with several portions to achieve the performance of the 150 μm (No. 100), removing the material that passes through the 300 μm sieve (No. 50) before scrubbing the rest [5].

2.4 ASTM C342

This test method is a modified mortar bar expansion test to determine how many different mechanisms such as ASR could theoretically expand a certain combination of cement aggregates. It was primarily used in Oklahoma, Kansas, Nebraska, and Iowa in aggregate studies (Conrow 1952). The test involves sending mortar bars to varying humidity and temperature storage conditions and measurement periods up to one year a year. For this phase, ASTM C342 notes that no limitations have been placed on the admission of expansion. ASTM C342-97 has been deleted in 2001 [6].

2.5 ASTM C295

This guideline paper details how the sample representative materials are generated as aggregates in cemetery mixtures and describe how petrographic methods are applied, the selection of properties, and the use of these for testing concrete aggregates. All studies on aggregations in concrete should be conducted by a petrograph with at least five years' experience in petrographic research for concrete or concrete materials. Also, the petrographer should have experience with the proper use of equipment and apparatus and be completely aware of a petrographic examination. In the petrographic test of a sample, the specific procedures used can depend to an

outsize extent on the intent of the exam and also on the nature of the sample. In the majority of cases, optical microscopy will be required. Complete petrographic examinations might involve an examination of the aggregates or elect constituents with suggestions for additional methods, such as x-ray diffraction (XRD) analysis, thermal differential analysis (DTA), different scanning microscopy (SEM), and energy-dispersive x-ray analysis (EDX). In general, the criteria for the random sample for concrete aggregates should be following practice D75 [7].

2.6 ASTM C1293

This control technique deals with the determination of the sensitivity or the corresponding mixture with pozzolan or scoria for participation by calculating the duration of modifications to concrete prisms in the expansive alkali-silica reaction. Follow the protocol of the test device C157/C157M except for saturated lime water, initial reading comparator. Tank sampling should not be in contact with water in the reservoir inside the storage container. The following reading is necessary for the testing of a compound in the aggregate at the age of 28 and 56 and also in the age of 3, 6, 9, and 12 months for the expansive alkaline reaction and in the additional 18 and 24 months for testing compounds with pozzolan and scratch. Remove the containers with 38.0 ± 2.0 °C prism environment, then put them in a temperature-controlled environment at 23.0 ± 2.0 °C for 16 ± 4 hours. All specimens in the container are simultaneously read for comparators [8].

2.7 Osmotic Cells Tests

A simple method that combines physical and chemicals effects of ASR is the osmotic cell test developed by Verbeck and Gramlich. Its usage reduces the mechanical effects of materials that make mortar and concrete test results complicating. It was used for the study of these variables and observation and monitoring of some chemical and physical aspects of the reaction process. Stark and Schmitt have recently taken the test to determine the potential for overall reactivity. In the sodium-hydroxide solutions, Verbeck and Gramlich used the test to analyze the effects of solid calcium hydroxide and others in the reaction mixes. In these experiments the reaction mixture in the reaction chamber (12 ml) was separated by a hardened cement paste membrane, containing the same amounts of solution and solid calcium hydroxide, but no reactive aggregate. After several days, the swelling rate of reaction products persisted and proceeded to flow into the reaction chamber for a few weeks. The effects of melting different calcium and opal volumes (less than 45 mm) steadily decreased the flux rate until 3 grams were added to the reaction chamber. This work showed that the flow could start after a certain delay [9].

2.8 Gel Pat Test (GPT)

Several calcareous silica plots are already recognized in Ottawa, Montréal, Trois-Rivièrees, and Quebec City as being alkali-silica reactive on cement. However, there are significant variations inside and between the regions in the degree of deterioration for concrete structures. It is mostly due to different levels of reactivity, such as the concrete content of cement and concrete, of alkali, and the conditions of exposure for the structures affected by alkaline, but also to factors related to the concrete compositions employed (application of de-icing salts, etc.). 65

samples were collected from 22 quarries. Five concrete prisms, size 75 mm x 75 mm x 300 mm have been developed for each aggregate under analysis. Four of them were checked in the CSA Standards and a fifth for gel pat testing. The concrete mixed is 3.18:2.19:1:0.50 and Na20, which was equivalent to 310 kg/m3, with an addition/sand/cement/water ratio of 350 kg/m3 and a total Alkali content of 1 to 25%. (CSA requirements specified). The effect was that NaOH was applied to the water mix. Longitudinal shifts have been assessed for up to two years. The Mortars bars with a heavy alkaline cement, but a fixed water/cement ratio of 0.50 (w/c), have been manufactured according to the ASTMC 227. Subsequently, the specimens were analyzed under NBRI laboratory conditions (or ASTM C9 P 214) [10].

2.9 ASTM C586

This kind of research includes deciding how the carbonate rock specimen expands when a sodium hydroxide solution is found at room temperature (NaOH). During this immersion, the length changes demonstrate the overall degree of reactivity of the rock and whether the impact of aggregate rock preparations on changes in concrete volume is controlled. Small rock cylinders are used in NaOH solutions except for the length shifting calculation. The length change for each specimen is periodically calculated. This testing technique aims to provide a relatively rapid indication that a potential expansion of reactivity can involve such carbonate rocks as concrete aggregates and should not be used this method as a basis but as a testing and screening method. Typical hydraulic cement alkaline reagents are mixed cement with the aggregate in concrete that may be extracted, under some conditions, from other concrete components or external sources. This test method is not ideal for detecting alkali-silica [11].

The length change is measured as follows to 0.01% of the reference length as:

$$\Delta l = ((l1 - l0)/ l0) \times 100$$

2.10 Nordtest Accelerated Alkali-Silica Reactivity Test

A very large-scale road system with Portland concrete was built in the 1960s. However, the concrete floors of some of the roads started to collapse about 4 years from the inauguration. An inspection of the core of these floors showed a significant reaction of alkaline aggregates. The alkaline content of the Portland cement was also expected to have played a small role in the breakdown due to the larger aggregate reaction, and NaCl, used as a deicer, was the main cause. The core components of an unused portion of the road were placed in water and a NaCl solution and kept at 50°C. Within 3 weeks the solution of NaCl developed cracks and other signs of an alkaline aggregate reaction, while the water remained unchanged. As a rapid method for detecting alkaline aggregate sand and stone reactivity, a work program was initiated. Due to the promising results obtained to date and the simplicity of the technology, it is considered of interest for other employees. Three sand forms were available: ISO Standard Sand, Nymolle Sand Fraction of 0-4 mm, and ISO Standard Sand of 50:50. Low alkaline Portland cement was used in this study. The raw materials above were made of three lots of mortar. The 1:2:0.5 cement: sand: water ratio was present in these mixes. From each of those mixes, 40 x 40 x 160 mm prisms were thrown out. After 28 days of water healing, the prisms were divided into two classes so that each of

the combinations contained at least two prisms. After initial tests, one group was placed in water and the second group was put in the saturated NaCl solution. The solutions were held at 50°C. These prisms were cooled once a week at 20°C and the solution was weighed [12].

2.11 Japanese Industrial Standard (JIS A1146)

This standard calculates the alkaline-silica reactivity of the aggregates by measuring changes in the length of the mortar bar. This is referred to as the method of the mortar bar. However, for artificial lighter aggregates, the concrete aggregation cannot be used (coarse, fine). In addition, the aggregate clauses for hardened concrete are removed. The unused aggregate is the aggregate used for the test in fresh concrete. New Specific Wash the cement pastes thoroughly if the aggregate comes from inside. The sample is rough, the materials extracted and the fine aggregates are about 40 kg. When the mortar bar procedure is carried out using the chemical method, the samples obtained are used at the same time. The mortar molding chamber and the measuring chamber shall be kept at a length of 20 ± 3°C and the container is kept to a temperature of 40 ± 2°C and relative humidity is maintained at or above 95%.

As for the method of taking samples, the following should be followed:

Three specimens are prepared for a one-batch examination, and the mortar formula should be (Cement 1, water 0.5, and samples 2,25) are a composition of the mortar with particle size modified in dry condition: Water + NaOH Solution 300 ± 1 ml, Betons: 600 ± 1 g, modified particulate sample size (dry front): 1350 ± 1 g, the amount of aqueous NaOH so that Na2Oeq's gross cement alkalinity is 1.2%. Then weigh materials by weight up to four important figures. Start and mix for 30 seconds when the paddle turns. Stop kneading and add the quantity of water you said. After 30 seconds the kneader was working, but it stopped for 20 seconds. Keep on the dough for the rest and paddle. Extract the mortar with a spoon. Remove the mortar several times to remove the dough on the bottom. Have a break. Remove and mix for 120 seconds until finished. Pack the mortar directly into a mold in two layers. Spread and apply a sticker to the mortar at half the coating height. Place the edge about 15 times on each specimen to match 5 mm/sheet. Using a punching stick, the top surface is carefully removed and smoothed away to prevent damage to the specimen. Put the entire mold into a humidity box for up to 24±2 hours after kneading, do not touch the surface of the mortar to dry the cover in a moist cloth and cure first. For measurement of the duration, the calculation is based on JIS A 1129-3, and the samples should always face the same side during measurement. During standard scale calculation, the formula (Xi1-Xi2) of JIS A 1129 is explicitly determined. Display warping, changes like pop-outs, surface breaks, water when measuring changes of length. Watch for exudates like gel and dirt in the glass [13].

2.12 Rapid Method for Identification of Alkali Reactivity of Aggregate

The alkali-aggregate reactivity can be measured in expansion quantitatively but usually, in six months to one year, the results are drawn (or at least three months). Different techniques have been therefore studied for the speeding of an alkaline-silica reaction, like Chatterji's suggestions for increased alkaline concrete content or cement aggregate ratio and storage of NaCI solution bars. There is a general conclusion that the results at

temperatures above 37.8 °C are not accurate, although several experiments were conducted with the objective of speeding up alkaline silica reactions by increasing temperatures. For the alkaline silica expansion test, the standard temperature is, therefore, to be carried out at 37.8°C. The average temperature of Duncan and his colleagues was only 64°C. Several experiments have shown that the alkaline hydroxide solution autoclave-treated mortar bars can accelerate alkaline silica response and enhance the expansion value. The autoclaving temperature is, however, the most sensitive element in the alkali-silica reaction. The expansion of quartz sand, perlite, and opal mortar bars and the conditions of testing:

1) 1x1x4 cm of mortar bar; 10:1 cement bar: aggregates; 0.15-0.75 mm of aggregate size; 0.30 w/c of cement alkaline Na2O, and + 1.5 percent. The mortar bars have been removed from molds after the one-day curing process and are then healed for 4 hours by the steam of 100°C, put into the 10% KOH and autoclave solution, and processed for six hours at different temperatures.

(2) the equivalent of alkaline material was essentially handled similarly, except 1.72 percent. The concentration of Na2O and KOH solution was 24%. Based on these experimental findings, from Figure 3.4 we have decided on 150°C as the optimal temperature for autoclave treatment.

The results showed that expansion values for cement paste and quartz sands are very small and autoclaves are processed at 150°C for mortar bar expansion (sometimes just 0.02 percent). However, at least 0.105 percent with most of the above 0.25 percent were reactive aggregate expansion values. This indicates a wide distinction between the expansion values of the reactive and not reactive aggregates, which led to their distinction. Experiments also show that the test results in ASTM C289-71 and the accelerated test are reliable to a certain extent. The results of the test for non-reactive aggregates reveal that the value for non-reactive aggregates is approximately the same as for reference specimens. Experiments also have shown that they are highly compatible with accelerated test performance ASTM C289-71 and ASTM C227-71 [14].

2.13 ASTM C1260

The method of research enables deleterious aggregate reactions to be identified in mortar bars within 16 days. This evaluation method provides a way to detect the potentially harmful internal expansion of a concrete concept for the alkali-silica reaction. This method is based on the NBRI accelerated test system. As the specimens are exposed to NaOH solution, the alkali content of cement is not an important factor affecting expansion.

There are additional information sources include:

1) Petrographic aggregate analysis to determine whether known reactive components are present.

2) tests of specimens after alkaline reaction products have been tested.

3) field service reports, as long as they are available, can be used for performance assessment.

When testing results using the test method and additional knowledge that such aggregates should be viewed as potentially deleterious reactive, the application of mitigative steps like low-alkaline Portland cement, mineral admixtures, or soil granulated blast furnace slag shall be evaluated.

In this method, many reactors are used:

- Sodium hydroxide (NaOH): concentration between 0.99 N and 1.01N in the Na+ and OH− concentrations can be found to be between the 0.99N and the 1.01N.

- Purity of water: Water references to reagent water, as specified in Type IV of D1193, shall be interpreted unless indicated otherwise.

- Sodium hydroxide solution: every liter of a solution should be diluted by additional distilling or deionized water, dissolved in 40.0g of NaOH, and formed by 1.0 L solution.

The commitment must be made to create appropriate conditions for this test method as following:

- Maintain temperature at 20°C and 27.5°C for the room and dry materials molding, no more. The temperatures of the mixing water and wet room should not differ from 23°C by more than 2.0°C.

- Maintain relative dampness of the molding room at not less than 50 percent.

- Hold the oven or bath, whereby the samples are stored and stored in containers, at the temperature of 80.0 ± 2.0°C.

For aggregate selection and preparation: classify the sample in accordance with the following table.

Grading Requirements

Table 2

Sieve Size		Mass %
Passing	Retained on	
No. 4	No. 8	10
No. 8	No. 16	25
No. 16	No. 30	25
No. 30	No. 50	25
No. 50	No. 100	15

The difference between the zero-comparative reading of the exemplifier and reading at each time is the nearest 0,0001% of the effective measuring length and report as the specimen expansion. State the combination expansion of the three specimens of a specific cement aggregate combination at the closest 0.01% for that time [15].

2.14 Uranyl Acetate Gel Fluorescence Test

A new in situ method to identify ASR products was proposed to look at ASR concrete materials as gelatinous silica and its crystalline alterations using adsorbed sodium, potassium, and calcium ions. The replacement of adsorbed Na+, K+, and Ca ++ on silica gels have been shown to be significant in numbers. Uranyl (UO2++) ion was selected for its usual fluorescence by ultraviolet light. Uranyl acetate solution was used for the treatment of specimens and ultraviolet light was seen in darkened surroundings under a short wave once properly conditioned. A distinctive greenish-yellow fluorescence of the ion was suggested in the presence of gel. The mortar bars used in this study were produced for the expansion test ASTM C227. The bars were made of 0.95% cement equivalent to Na2O. The bars on the No.8 sieve had 20% Opal, and calcium was broken. The harmless body. The bars were divided over 45 days, with an average growth of 0,15%. The thin sections were examined initially in a polarized (PP) and crossed (XN) manner. Opal particles and the existence of ASR reaction gel were simply identified. A petrographic microscope was used as a laborlux with transmitted and reflected light capabilities. When a UV wave (1800-2800 A) is excited by Uranyl Ion, the ion has strong fluorescence. The thin surface was later polished to support quantitative studies with 5 microns, 1 micron, and 0,05-micron grains. In order to find ASR products first, and then an electron micro-sample for the composition of the ASR products, the petrographic microscope was examined. Then uranyl acetate was treated for the thin part and fluorescence with the aforementioned petrographic and UV light were observed. There was no effort to repolish the specimen after treatment with uranyl acetate. In electron microprobe research a Joel Superprobe 733 device was mainly used with the mode Wavelength Scatter (WDS). The table below explained Electron Microprobe Analysis Results [16].

Table 3

	Percent composition by weight			
Oxide	Cement matrix	Gel	Discolored rim	Opal
Sio2	20.55	65.72	83.84	89.48
CaO	37.24	15.32	4.85	0.14
K2O	0.0	4.3	2.64	0.16
Na2O	0.0	0.38	0.31	0.0
Al2O3	1.18	0.48	0.6	0.31
FeO	0.82	0.0	0.18	0.0
Balance	40.82	13.81	7.59	9.91

2.15 Simple Chemical Method for The Detection of ASR of Aggregates

The approach suggested includes the suspension of a CaO mixture and an assessment in an alkaline solution, preferably a KCI, which is held at 70 C. The filter's concentration of OH-ion shall be refreshed, filtered, and weighed after 24 hours. The OH ion level is then treated in the same way as a control suspension in a mixture of quartz sand and CaO. Latest reports indicate that Na+ ions of NaCI and Ca(OH)2 ion join reactive grains in the

NaCI process in accelerated testing of the aggregates for their alkaline-silica responsiveness, leaving Ca++ or Cl-Ions in the liquid phase. In the fluid stage of the reaction, CaCI2 is produced. The concentration of CaCI2 is determined by the reactivity of the aggregate. This new CaCI2 would also reduce the solubility of Ca(OH)2 by the common effect of ion, i.e., depressing OH-ion and [Ca]/[OH] is greater than the solution of pure Ca(OH) 2. On the basis of those observations, the aggregate's alkaline silica reactivity can be computed by storing the aggregate at high temperatures e.g., 70°C and measures its ion concentration, and comparing it with the quartz control suspension in a Ca(OH) 2 suspension. A sample of pure quartz sand (Vorvadsbro sand) and two forms of reactive sand were used in this analysis. Kallerup is more reactive than CN sand of the two reactive sand types. For the making of suspensions, a freshly burned sample of CaO and a saturated KCI solution (at room temperature) were used. A Pyrex glass tube is combined in a 120 ml KCI solution and 3.5 g CaO. The tube was tightly stopped and packed in a 70°C oven. A 0.45 µm membrane filter was used to filter the liquid phase of each tube under suction. The OH-ion concentration of each filtrate was calculated using phenolphthalein as the indicator by titration to a solution with a 0.025 N HCI. Ca(OH) 2 solubility was determined in the Saturated KCI solution Treat a 120 ml and 3.5 g CaO mixture exactly as above [17].

2.16 Short-Term Concrete Prism Test Method (SCPT)

Dr. Alkan HAFCI carried out this method as a doctoral study. To these aggregates apply newly developed test methods. The results of newly developed testing methods were used for monitoring by "RILEM AC-219 AAR-2 testing techniques for aggregates," "RILEM AAR-4.1 test method using concrete prisms" and also modified AMBT (at 60 °C). These new methods were used with the use of a different soaking solution with NaOH and chlorides, pressed concrete prisms (50 x 50 x 200 mm), and a size distribution within a certain size of the available analyses. The results of these processes are also available.

Different soaking solutions for the most suitable testing method:

- 0.3 N NaOH + 1% NaCl + 1% Cl2
- 0.3 N NaOH + 2% NaCl
- 0.3 N NaOH + 2% CaCl2
- 0. 3N NaOH + 2% MgCl2
- 0.35N NaOH + 1% CaCl2
- 0.35N NaOH + 2% CaCl2

Moreover, petrographic and mineralogical assessments have been made of several kinds of aggregates to measure the effect of these properties on possible alkalis, in order to further monitor the reliability of the new method. In 28 days, compared to 20 weeks of concrete prism testing, the new approach is implemented much shorter. Aggressive crushing and handling of the aggregates and alkaline liquefaction testing are different than the AMBT (Accelerated Mortar Bar Testing Method). Typically found samples can be observed using CPT procedures. The results of the 28-day expansion of the new system were highly correlated with the results of the CPT method in 20 weeks with a comparative analysis of 32 aggregate styles. The new method of evaluating AAR as an alternative and reliable method is demonstrated by these conclusions. The used materials in this

study were:

Aggregate: 8 identified aggregate types and likely reactive and suspect experimental analyses were performed. The last experimental study was finalized with two new methods for 24 additional aggregates. The study was completed by (32 in total).

Cement: two cement types I 42.5 R have been used which are defined by the related standards "ASTM C150 or TS EN 197-1." In this experimental trial, Na2Oeq = 0,9-1,3 percent of the alkaline equivalent are used to test methods with related RILEM requirements, so cement types are selected accordingly.

Sodium hydroxide (NaOH): The most common chemical element, Alkaline concrete material is available for up to 1,25 percent Na2Oe according to the AAR test requirements. The technical sentences define only a guideline for NaOH not less than 98 percent pure.

Deicers (salts) based on chloride: There are 3 types (1) Calcium chloride (CaCl2) (3) Magnesium chloride (NaCl) (MgCl2) [3].

3. Results

This part of the article will highlight the results of the above-mentioned methods.

3.1 Stanton method

If the alkaline cement content was less than 0.6 percent, the expansion was found to be negligible and another conclusion was that the high alkaline cement was not overly expanded by replacing the required pozzolanic content [3].

3.2 ASTM C227

The differences in specimen expansion of any group from the average expansion of the group **shall be considered satisfactory** where the differences do not exceed 0.003 Precision. Except that where the mean expansion exceeds 0.020 percent, **the repetitiveness is considered to be satisfactory** if the percent expansion of each specimen molded by the same cement combination is within 15 percent of the average [4].

3.3 ASTM C289

Preliminary precise data suggest that if no value of the 3 values of Rc (and Sc) varies from the avg. of 3 values by more then the test results can be acceptable.

1. if the average is 100 mmol or smaller, 12 mmol/L.

2. if the average of the 3 values is greater than 100 mmol/L, 12 percent. [5]

3.4 ASTM C342

ASTM C342 notes that there are no restrictions on accepting expansion. However, the work of the ASTM subcommittee has shown that an increase in Alkali-Silica Reactions of 0.020 percent or more may not be acceptable in the first year [6].

3.5 ASTM C295

After the sample has been found to possess properties or constituents that square measure better-known to possess specific unfavourable effects in concrete, those properties or constituents ought to delineate qualitatively and, to the extent practicable, quantitatively [7].

3.6 ASTM C1293

Average Expansion Less Than 0.014%: The outcomes of two experiments on the same aggregate should not vary by more than 0.009% in separate laboratories.

Average expansion More than 0.014%: the outcomes of two experiments on the same aggregate in separate laboratories cannot vary by more than 65% of their average.

Average expansion Less than 0.02%: In computing an average test result, 19 of 20 does not surpass 0.008 percent.

Average expansion Greater than 0.02%: The average test results do not exceed 40% of the average, 19 of 20 times [8].

3.7 Osmotic Cell Test

After a rather opal dissolution followed by continuous penetration and reaction of C-N-S-H or N-S-H with OH-, Na+ and Ca++ ions, an initial surface reaction occurs. For each chamber, the volume measurements include dissolution changes, reaction changes, and fluid flow changes. In cement pastes less than 0.5 w/c, seed ions are present. A cement paste membrane passes through free waters, NaOH solutions, and ions. Solid calcium hydroxide initially produces a healthy reaction time; some silica breaks and precipitous C-N-S-H on the surfaces of opal particles; OH-, Na+, and Ca ++ penetrates and reacts to C-N-S-H in an internal region. Dissolution and reaction shift to the reaction room in negative volumes and the initial spread of water and ions. Calcium hydroxide increases in the reacted opal surface and slows the start and the swelling into the reaction chamber. This leads to thicker C-N-S-H layers. Then depends on the constant flow rate:

- surface layer densities were determined to penetrate ions, OH-, Na+ and water.

- The unreacted volumes of opal.

Diffusion rates other than the reactive aggregate particles may also affect the relationship of the time delay in

the osmotic cell test to pore solvents of the same concentration, where the rate restriction phase in the reaction is the case [9].

3.8 Gel Pat Test (GPT)

Most of the specimens examined did not produce gel nor trace gel in the gel pat test (GPT<0,10) of the dolostones in the Chazy, Beekmantown, or Trenton group of limestones with less than 5% of insoluble residuals. In both these specimens, less than 25 percent of the particulate aggregates had gel deposits. There has also been no expansion in the concrete prism test, and everyone well knows that the field efficiency is excellent. The concrete expansion exceeding the proposed 0,04% limit and the deleterious output in this field have been shown. All rock specimens tested in this study showed GPT rates above 1.10 and 89 percent of the gel deposits were more than 75 percent. The expansion of the concrete prism test (CSA A23.2-14A), and the accelerated NBRI mortar bar test (ASTMC9 – Proposal – P214) revealed that the amount of gel provided by the appropriate gel pat test specimens was, despite the significant dispersion of the information, reasonably positive. However, the process of expansion of reactions may affect other factors, like porosity and permeability of aggregate particles, when particles are confined to concrete [10].

3.9 ASTM C586

Where no particular measurement times are required, the data should be submitted at least for 1, 4, 8, and 16 weeks and the age at the final measurement age. If the duplicate results, determined by the same operator, representing probably the same material, vary by more than 0.10 percentage point for expansions of less than 1.0 percent, then rocks that are substantially different in chemical composition, texture, or both are highly probable [11].

3.10 Nordtest Accelerated ASR Test

The median expansion was around 0.08% and did not differ significantly between the mixes. The findings of this research are in line with the use of low alkali cement. There was a gradual but minor expansion of the prisms found in ISO sand to the point of stoppage and no signs of distress [12].

3.11 Japanese Industrial Standard (JIS A1146)

The judgment of alkali-silica reactivity of aggregate is judged as "harmless" when the average coefficient of expansion of three specimens is less than 0.100% at 26 weeks of age, and "harmful" when it is 0.100% or more. If the material to be measured shows an expansion of 0.050% or more at 13 weeks of age, it may be considered "harmful" at that time. In that case, the measurement at the age of 26 weeks may be omitted. If the material age is 13 weeks and less than 0.050%, it should not be judged as "harmless" at that time and should be judged after continuing the test until the material age of 26 weeks [13].

3.12 Rapid Method for Identification of Alkali Reactivity of Aggregate

By examination under a microscope, it indicates that the contour of quartz sand was clear when the temperature was below 150°C, which means that almost no reaction existed between the sand and the alkali. Above this temperature, obvious signs of alkali-silica reaction were found. In two days, it can be easily achieved in practice by defining the alkaline reactivity of the aggregate and the combination of the quick approach with the microscope observation helps to explain the unexplained alkaline-aggregate reaction mechanism [14].

3.13 ASTM C1260

Expansions below 0.10% at 16 days after casting suggest in most cases harmless behavior. Expansions of more than 0.20% at 16 days after casting can be a sign of deleterious development. The 0.10 to 0.20% expansions in the 16 days following casting provide both unheard of and deleterious aggregates in field quality. In such a scenario comparator reading can also be useful for 28 days [15].

3.14 Uranyl Acetate Gel Fluorescence Test

1. The microscopic evidence given confirms that only gel products of ASR can be identified by the simple identifying technique for ASR.

2. Petrographic and micro samples demonstrate that uranyl ions are correlated with fluorescence and occur where these ions were adsorbed only [16].

3.15 Simple Chemical Method

The results show that the saturated KCl-Ca(OH)2-sand suspension's OH ion concentration is inversely proportional to the sand's reactivity. This technique would then form a basis for a fast and easy procedure to detect the alkali-silica reactivity of concrete aggregates if this finding could be repeated with other workers. The decrease in OH-ion levels may be compared by an aggregate with the expansion of concrete induced and a criterion of acceptance may be drawn [17].

3.16 Short-Term Concrete Prism Test Method (SCPT)

In the measurement of test aggregate reactivity, SCPT data show excellent consistency with the CPT data. The rate of expansion (0.04%) may be acceptable in the standard error margin due to the insecurity of measurements of experimental studies. The new approach (SCPT) thus eliminated one weakness of the test methods available [3].

4. Conclusion

In this study, the comparison between the above-mentioned methods was based on the following parameters:

Duration, Temperature, Specimen size, Tested mix type, Used aggregate, Admixture, Water/Cement ratio (w/c), Expansion limit.

And the comparison process was in three stages, the first was between short-term methods only and the second stage was between long-term testing methods and the last stage was between short-term and long-term methods, and all stages were compared to the EM 1110-2-2000 standard that showed:

- Measured expansions above 0,10% at any age show a possible deleterious reactivity of the aggregate.

- Measured expansions of more than 0,05% at 6 months, but less than 0,10% at 1 year generally indicate that, in borderline cases, the slope and trend of the changes in length versus time curve for assistance in interpretation should be examined.

- The bars are stored in 100% RH and a 60 ° ± 5 °C (140 ° ± 10 °F) temperature [18].

4.1 Stage1

When the ASTM C295 duration-based methods are compared, the best method is to compare them with the SCPT method when using the SCPT temperature. When the comparison is carried out based on the specimen size, the best method cannot be determined because each method has a specific test pattern. The best of the tested mix types are concrete prisms since they represent all the substances used in concrete formation, such as the Gel Pat and SCPT test. If test methods are compared based on aggregate type, the best cannot be determined until a specific aggregate type is tested using different methods. The comparison due to the admixture material has shown that sodium hydroxide was used in most test procedures. Furthermore, the comparison was made with the w/c ratio. The best was ASTM C1260. Every method had its limits for comparison based on the expansion limit, but all methods were compared with EM 1110-2-2000 in this study.

4.2 Stage2

If you compare all processes required for 1 year or more based on duration, ASTM C342 can consider the best compared to the temperature withdrawn. The best cannot be determined if the sample sizes are compared, because every method has a specific model for testing. The use of a concrete prism is the best of the tested mixing form since it reflects all the concrete materials, such as those used in ASTM C1293. Furthermore, only after evaluating a certain aggregate type using different methods while comparing test methods based on the aggregate type can the best testing method be determined. The comparison due to the admixture material has shown that sodium hydroxide was used in most test procedures. ASTM C1293 was the best when the comparison was done according to the w/c ratio. While each method had its comparison limits according to the expansion limit, in this study, all methods were compared with the EM 1110-2-2000.

4.3 Stage3

Compared to ASTM C295, the best method is compared and the best one is compared to SCPT based on the temperature. The best comparison was not possible based on the specimen's size, because there was a certain test pattern in each method. The concrete prisms Gel Pat Test, SCPT and ASTM C1293 have used, are therefore considered the best methods by type of the mix, as the concrete prism is designed in order for all the materials

used in concrete forming to be represented. In addition, a comparison of test methods based on the type of aggregate cannot be determined by the best method unless different methods are used to test a certain type of aggregate. The comparison by the mixed material demonstrated that most sodium hydroxide test methods were used, and the comparison with w/c showed the best of ASTM C1293. Finally, the comparison of EM 1110-2-2000 was significant, based upon the expansion limit, and showed that each method had its limitation.

5. Recommendations

- This study offers you preferences as to how to select the best alkali-silica screening experiment.
- The preferable method for short-term test methods is ASTMC1260, but it is recommended that the SCPT method be developed to make it suitable for all test conditions and accepted as the researcher has made great efforts to link the characteristics of the test in the short- and long-term.
- Prefers to use ASTM C1293 for long-term testing methods because it's regarded as one of the most recent and approved ASTM long-term methods.

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